

2. DISCUSSION OF REMEDIATION ACTIVITIES

2.1 Remedial Action Working Documents

The *Waste Area Group 5 Remedial Design/Remedial Action Work Plan, Phase I* (DOE-ID 2001) lists the design criteria, describes the remedial design and how it was implemented for the remedial action, and serves as the guidance document for the WAG 5 Phase I remedial action. The following documents were included as appendices to the RD/RA Work Plan:

- Design Drawings that detailed the prerediation conditions (e.g., topography and fencing at each site), as well as the work to be performed during the remedial action
- Technical Specifications that provided the general terms and conditions required for completion of the remedial action
- Engineering Design Files with technical information pertaining to the remediation
- Quality Designation and Record that assigned a quality level to the remedial action
- Air Emissions Modeling Results that presented a summary of the results of the air emissions necessary to satisfy project Applicable or Relevant and Appropriate Requirements
- Cultural Resources Summary that described the cultural resource investigations, conclusions, and recommendations for WAG 5
- Waste Management Plan that described the management and disposal of wastes generated during Phase I activities
- Cost estimate, basis for the estimate, and related assumptions.

In addition, three separate documents were included with the Phase I RD/RA Work Plan (DOE-ID 2001):

- The Field Sampling Plan (DOE-ID 2000b) described the sampling and analyses required during Phase I activities
- The Quality Assurance Project Plan (DOE-ID 2000c) described the necessary steps required to ensure the quality of project data
- The Health and Safety Plan (HASP) (INEEL 2001) described the possible hazards and required steps to protect the health and safety of the workers.

2.2 Site Preparation and Mobilization

The following subsections discuss the site preparation and mobilization efforts performed prior to the start of the remedial action.

2.2.1 Personnel Training Requirements

Prior to the start of fieldwork, all task-site workers were required to have the following training as specified in Section 4 of the HASP (INEEL 2001):

- Site-specific training as required by the HASP (INEEL 2001)
- 40-hour hazardous waste operations and emergency response (HAZWOPER)
- Hazardous Waste Operations 24-hour “on-the-job” training
- 8-hour HAZWOPER site supervisor, as necessary
- Hearing conservation
- DOE Radiological Worker II/Radiological Worker I
- Respirator qualification and fit test, as necessary
- Hazardous materials employee general awareness training.

Certifications of training and training updates were maintained in the training database on the INEEL Intranet.

2.2.2 Field Operations Office and Staging of Equipment and Supplies

The field office trailer utilized for the OU 5-12 Phase I remedial action was established at the ARA-I facility. This field office trailer had been used previously to support the deactivation, decontamination, and dismantlement activities at the ARA facilities; therefore, it already had electrical and phone connections in place. Additionally, the trailer had an external loudspeaker and personnel emergency warning device to alert personnel working in the vicinity of the trailer in the event of an emergency. Temporary restroom and wash facilities were established near the trailer for workers, in accordance with the Occupational Safety and Health Administration standard, 29 Code of Federal Regulations (CFR) 1910.120/1926.65, “Hazardous Waste Operations and Emergency Response (HAZWOPER).” Flammable materials storage was established, and the field office was stocked with personal protective equipment (PPE) including leather gloves, safety glasses with side-shields, and sunscreen for the field team members. Communications equipment at the job site included a combination of pagers, two-way radios, cellular telephones, and the landline telephone in the field trailer.

Equipment required to perform the work was staged at the work site prior to beginning the remedial action. Equipment included, but was not limited to, front-end loaders, excavators, backhoes, pumps, generators, sampling equipment and supplies, PPE, waste storage/disposal containers, and signage and barricade materials.

2.2.3 Regulatory Compliance

The OU 5-12 remedial action was required to conform to applicable or relevant and appropriate requirements, as outlined in Section 4.2 of Phase I Work Plan (DOE-ID 2001).

2.2.4 INEEL Work Control Requirements

In compliance with INEEL procedures and requirements for conducting fieldwork, the following items were required to be completed prior to the start of the remedial action:

- Standard-101 Work Packages
- Project listed on Central Facilities Area (CFA) Work Planning Schedules
- Formal prejob briefing for each work package
- Radiological Work Permits
- As low as reasonably achievable (ALARA) review (as applicable)
- Safe Work Permits
- Subsurface Investigation
- National Environmental Policy Act documentation and Environmental Checklist
- Storm Water Pollution Prevention exemption
- Spill prevention and control measures
- Cultural Resources Survey.

Prior to the start of work, general activities that were required each day included plan-of-the-day meetings to review the day's work activities, daily equipment inspections, and calibration of radiological survey and industrial hygiene instrumentation. Additionally, as part of the closeout of each work package, formal postjob reviews were scheduled and conducted.

2.3 Remedial Action

The remedial action consisted of the excavation, removal, or abandonment of piping and tank systems, backfilling of excavations, stabilization of the sites, and implementation of institutional controls. The following sections detail the remedial activities that occurred at the OU 5-12 Phase I sites. Deviations from the original work plan are noted, and a detailed discussion of these deviations is presented in Section 4 of this report. The details of the remedial action field activities are contained in the INEEL Environmental Restoration Operations Field Team Leader's Daily Logs.

2.3.1 Site Preparation

Site preparation activities included clearing and grubbing (where necessary), removing existing fences and other barriers, and establishing access-controlled work areas including exclusion zones, contamination reduction corridors, and work site access points. Specific site preparation activities for each of the sites are detailed in the following subsections.

2.3.1.1 ARA-02 Sanitary Waste System. Site preparation at the ARA-02 site involved the establishment of the work control areas and controlled access points to the work area. Portions of the soil contamination area fence were removed and temporarily replaced with yellow and magenta rope and

signs. Yellow and black rope and signs were used to designate the exclusion zone. Vegetation was removed from the soil covering the portion of the ARA-02 piping, septic tanks, Manhole #3, and the seepage pit. Additionally, vegetation was removed from the equipment staging area to mitigate the potential fire hazard. Roll-off waste containers for storing and shipping the waste were staged at the site.

2.3.1.2 ARA-07 ARA-II Seepage Pit to the East. Site preparation activities at the ARA-07 site included removal of the chain-link fence and metal fence posts surrounding the seepage pit to allow access to the seepage pit and roof structure. Work control zones were established to prevent unauthorized access to the work site. The radiological control technician surveyed the fencing and metal posts, and no contamination was identified. The fencing materials were dispositioned at the INEEL conditional industrial waste landfill. Vegetation removal was not required.

2.3.1.3 ARA-08 ARA-II Seepage Pit to the West. Site preparation activities at the ARA-08 site included establishing work control zones to prevent unauthorized access to the work site. Minor vegetation removal occurred during the excavation of the seepage pit.

2.3.1.4 ARA-13 ARA-III Sanitary Sewer Leach Field and Septic Tank. Site preparation activities at the ARA-13 site included establishing work control zones to prevent unauthorized access to the work site. Vegetation removal was not required. Equipment, including a portable electric generator and sampling supplies/equipment, was staged at the task site in preparation for the liquid and sludge sampling. Upon receipt and evaluation of validated sampling data, pumps to remove the waste, waste containers, dry cement mix to remove free liquids from the waste, and heavy equipment were staged for the excavation, cleaning, and abandonment in place of the ARA-13 system components.

2.3.1.5 ARA-16 Radionuclide Tank. Site preparation activities at the ARA-16 site included removing the chain-link fencing and metal fence posts surrounding the tank vault to allow access to the tank and establishing work control zones to prevent unauthorized access to the work site. Vegetation removal was not required. Equipment was staged at the area including excavation equipment; equipment for sizing the pipe, pumps, and hoses to remove the tank waste; pressure washers and clean water for decontamination; secondary containment; emergency spill control equipment; containment tent; waste containers; materials to stabilize the liquid waste; and grouting equipment.

2.3.1.6 ARA-21 ARA-IV Test Area Septic Tank and Leach Pit No. 2. Site preparation activities at the ARA-21 site included establishing work control zones to prevent unauthorized access to the work site. Vegetation removal was not required. Equipment, including a portable electric generator and sampling supplies and equipment, was staged at the job site in preparation for the liquid and sludge sampling. Upon receipt and evaluation of validated sampling data, pumps to remove the waste, waste containers, materials to solidify the liquid waste phase, and heavy equipment were staged for backfilling the tanks and leach pit and abandonment in place of the ARA-21 system components.

2.3.1.7 ARA-25 Soils beneath the ARA-626 Hot Cells. As mentioned previously, the ARA-25 soils, concrete foundation, and roof structure were removed along with the ARA-16 hot cell piping; therefore, the work control zones and heavy equipment staged for the ARA-16 remedial action were also used at the ARA-25 site. Additionally, soft-sided containers and the loading/lifting fixture for the packaging of soils and concrete debris were staged at the site. Additional heavy equipment included a crane for lifting the hot cell roof and placing the filled soft-sided containers onto the transport truck.

2.3.2 Remediation Activities

2.3.2.1 ARA-02 Sanitary Waste System. The initial activity of the ARA-02 remedial action was to inspect the three manholes for the presence of liquids. Upon inspection, it was found that the lid for

Manhole #1 had previously been removed and the manhole had been filled with soil. Manholes #2 and #3 were found to be free of liquids and were empty. Excavation of the sanitary waste system began just south of the ARA-626 hot cell and proceeded south toward Manhole #1. Excavation then proceeded in an easterly direction toward the seepage pit. Red concrete electrical duct banks were found near the former boundary of the ARA-626 building up-line from the septic tanks. The electrical duct bank was not energized and was located near the heated waste storage units that are part of the CERCLA Waste Storage Area (CWSA), PBF-ARA-I-CARGO-A. The duct bank that services the CWSA is normally energized; therefore, prior to proceeding with the excavation, a lockout/tagout was performed on the circuit. Upon isolation of the power source, excavation continued to the septic tanks, Manhole #3, and the seepage pit. The soil removed during the excavation was stockpiled adjacent to the trench for field survey. As the excavation progressed, visual inspections were conducted for evidence of system leaks. No visual evidence of leakage from system components was identified over the entire length of the excavation.

The piping, manholes, septic tanks, and other system components were removed and surveyed for organic and radiological contamination as the excavation progressed. The system components were staged near the excavation for size reduction and packaging. The sized components were placed into roll-off containers and representative samples were collected from each roll-off for waste profiling. The seepage pit sludge was also removed and packaged. All of the remedial action waste associated with the ARA-02 sanitary waste system was shipped to the Envirocare waste site in the state of Utah. Sampling and analysis and types/quantities of waste generated are discussed in Sections 2.4 and 5, respectively.

The bottom of the excavation was also surveyed for organic and radiological contamination. Field screening for organic contamination was conducted using a photoionization detector, and radiological control (RadCon) performed radiological surveys with calibrated Ludlum 2A survey instruments. Remote radiological surveys were also performed by the field crew from the radioanalytical laboratory and the INTEC remote inspection team, using the ANDROS robot and the Surveillance and Monitoring System (SAMS), as shown in Figure 2-1. The remote inspections allowed for specific radionuclide identification and were conducted at randomly selected points along the bottom and sides of the excavation. Additionally, field-screening samples were collected from selected measurement points and analyzed via gamma spectroscopy at the INTEC radioanalytical laboratory to verify that concentrations of Cs-137 were below the ARA-23 Phase II remedial action goal of 23 pCi/g for soils. The ARA-23 remediation goal of 23 pCi/g was used as the field screening standard for their soils because the surficial soil contamination in this area is attributed to the windblown soils that comprise the ARA-23 site. Each survey location was digitized in the field with a global positioning system, and the survey results for the ARA-02 site were mapped as shown in Figure 2-2.

The stockpiled soils from the excavation were also surveyed using the ANDROS/SAMS system to verify that Cs-137 concentrations were below 23 pCi/g. The field screening surveys did not identify organic or radiological contamination either in the bottom of the trench or in the stockpiled soils. Although Cs-137 concentrations in certain field screening soil samples were in excess of 23 pCi/g, further investigation in the field revealed that the activity was associated with surficial soils that were contaminated as a result of the SL-1 accident in 1961, as evidenced by the vegetation in the soil. This is because the Cs-137 contamination was found in the vegetation root ball indicating that it was associated with the surficial soils rather than the deeper soils located around the piping. These soils were screened in the field; separated from the clean, underlying soils; and placed back on the surface after backfilling the excavation with clean soils. These contaminated surface soils are part of the ARA-23 CERCLA site and will be remediated during the OU 5-12 Phase II remedial action. The soils underlying the ARA-02 seepage pit were field screened using a portable germanium spectrometer to verify that the concentration of Cs-137 was less than the 8.5-pCi/g remedial action goal. The measurement showed that the Cs-137 concentration in the underlying soils was 0.36 ± 0.013 pCi/g.

The ARA-02 excavation was backfilled using the clean stockpiled soil and backfill material from the CFA landfill complex. The excavation was then compacted and contoured to match the existing grade in accordance with the Construction Specification 02200, "Earthwork" (DOE-ID 2001).

2.3.2.2 ARA-07 ARA-II Seepage Pit to the East. The closure activities at the ARA-07 seepage pit included removal and disposal of the chain link fencing, roof structure, and top two courses of cinder blocks. This material was surveyed for radiological contamination and disposed at the CFA bulky waste landfill. A single hot particle was found on the roof structure. It was determined to be a beta-emitter, most likely strontium-90, at 10,000 counts per minute. Radiological control personnel disposed of the hot particle as radiologically contaminated waste in accordance with INEEL procedures, as outlined in the *INEEL Radiation Protection Manual*. The seepage pit was abandoned in place according to Idaho Administrative Procedures Act (IDAPA) standards, as outlined in IDAPA 58.01.03.007, "Septic Tanks Design and Construction Standards." The backfilled excavation was then compacted and tested to verify that the compaction was at least 85% in accordance with the Construction Specification 02200, "Earthwork" (DOE-ID 2001).



Figure 2-1. ANDROS robot and Surveillance and Monitoring System.

2.3.2.3 ARA-08 ARA-II Seepage Pit to the West. The closure activities at the ARA-08 seepage pit included excavating the site followed by removing, sizing, and disposing of the three concrete lids covering the seepage pit. The radiological survey of the lids did not reveal any radiological contamination allowing the lids to be dispositioned as conditional industrial waste in the CFA landfill. Clean backfill was hauled to the site and placed inside the seepage pit along with the soils excavated from the top of the seepage pit. The seepage pit was abandoned in place according to IDAPA standards as outlined in IDAPA 58.01.03.007, "Septic Tanks Design and Construction Standards." The backfilled excavation was then compacted and tested to verify that compaction was at least 85% in accordance with the Construction Specification 02200, Earthwork (DOE-ID 2001).

2.3.2.4 ARA-13 ARA-III Sanitary Sewer Leach Field and Septic Tank. Based upon review of existing analytical data and anecdotal information, it was determined that additional analytical data were required from the contents of the septic tank, manhole, and distribution box. Prior to any remedial

activities, samples were collected from the liquid phase in the septic tanks and distribution box, and the sludge phase in the manhole inlet, septic tanks, and distribution box. Results from the sampling are provided in Appendix C and summarized in Section 2.4. Based upon the analytical data, liquids did not contain any detectable man-made radionuclides or TSCA-regulated constituents, nor were they characterized as being hazardous. The sludge from the septic tank was considered low-level radioactive due to minimal quantities of Cs-137, but was not hazardous. The maximum concentration of Cs-137 was 0.182 ± 0.022 pCi/g. The sludge in the manhole was not contaminated. The sludge from the distribution box was also sampled, and concentrations of PCBs in excess of 50 parts per million (ppm) were found, causing the sludge to be regulated under TSCA. All sludges from ARA-13 were managed as low-level waste.

Based on the analytical results, liquid contents of the septic tank (estimated 8,706 liters [2,300 gallons]) were pumped and transferred to the CFA sanitary sewer system. The septic tank and distribution box were excavated to allow access to the sludge in the bottoms of the components. Upon excavation, it was found that the septic tank, depicted as a three-chamber tank in the as-built drawings, was actually three separate tanks in series. The top halves of each tank were removed, and dry cement and Aquaset were mixed into the sludge to remove any free liquids. The sludges from the septic tanks were then removed and placed into soft-sided containers and disposed at the RWMC. The sludge from the distribution box was removed and mixed with dry cement to stabilize any free liquids and was disposed at Envirocare. The tops of the septic tanks were surveyed and found to be free of radioactive contamination. As such, they were shipped to the CFA landfill for disposal. The ARA-13 system components remaining in the ground were then decontaminated, visually inspected, and surveyed for radiological contamination using standard RadCon survey techniques, as detailed in the *INEEL Radiation Protection Manual* to ensure compliance with IDAPA standards, as outlined in IDAPA 58.01.03.007, "Septic Tanks Design and Construction Standards." No radiological contamination was detected. In compliance with the IDAPA requirements, holes were made in the bottom of each component, and each component and the excavation were filled with earthen material.

2.3.2.5 ARA-16 Radionuclide Tank. The ARA-16 remedial action was initiated in fiscal year (FY) 2000. The piping was excavated and reconnected to the ARA-16 tank to drain any remaining free liquid into the tank. Initial attempts to decontaminate the piping prior to removal were partially successful and contributed an additional estimated 1,136 to 1,514 L (300 to 400 gal) of liquid waste to the ARA-16 tank. Following the attempt at decontaminating the pipe, a remote video camera was pushed from the tank end of the piping through the main 4-in. piping. Observation with the remote camera showed that the inside of the pipe was in good condition; however, there appeared to be significant quantities of metal filings and other debris that were not moved by the high-pressure, low-volume spray. Heavy debris was encountered approximately 27 m (90 ft) into the pipe, which forced suspension of the video inspection of the piping.

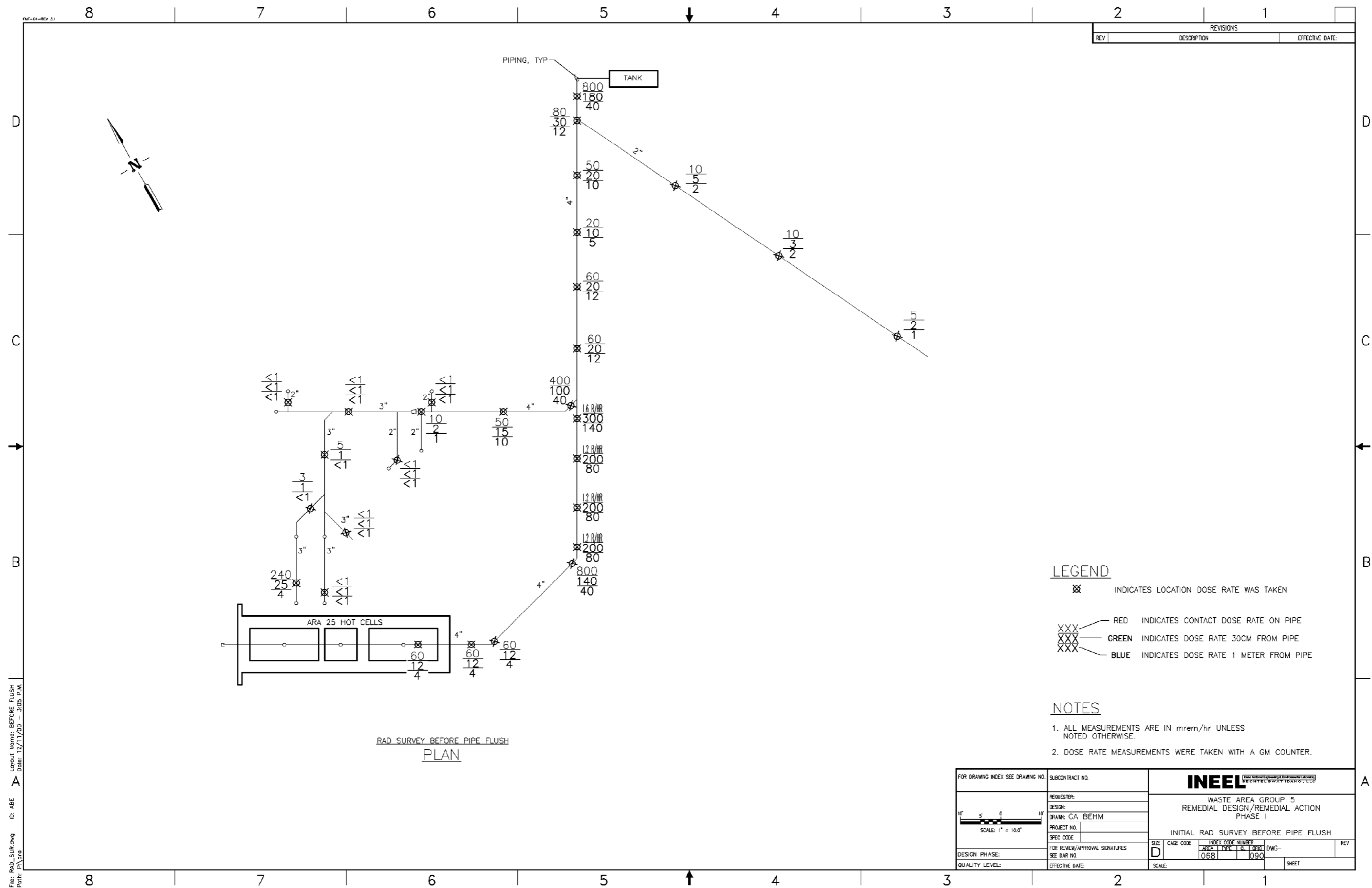
A radiological survey was also conducted on the exposed piping both prior to the decontamination efforts and immediately after to evaluate the effectiveness of the rinsing. The radiation survey maps prior to and following decontamination are shown in Figures 2-3 and 2-4, respectively. Additionally, a field portable germanium detector (ORTEC ISO-CART) was used in an attempt to identify and quantify the radionuclide contamination inside the ARA-16 piping. The results of the ISO-CART survey provided in Figure 2-5 show that the primary contaminants are Cs-137 and Co-60. For those sections of pipe with lower concentrations of radionuclides, the ISO-CART was placed approximately 0.3 m (1 ft) above the piping, providing an effective measurement diameter of 3 m (10 ft). For pipe sections with increasing concentrations, the ISO-CART was positioned further from the measurement location increasing this effective diameter up to 9.1 to 10.2 m (30 to 40 ft). As can be seen from the survey maps, the rinsing was minimally effective in reducing the radiation fields associated with the piping. The radiation fields associated with the piping were found to be higher than originally expected; therefore, the remedial action

was stopped until a plan could be formulated to handle the piping, while maintaining radiological exposure to personnel ALARA. Prior to the conclusion of the field activities at ARA-16 for calendar year 2000, a layer of sand was placed over and around the ARA-16 piping, and the excavation was backfilled to the existing grade.

The ARA-16 remedial action resumed in May 2001. The piping was re-excavated for removal following a new approach that had previously been discussed with and approved by the Agencies. The piping was cut into manageable lengths that would fit inside a waste box. Depending on the radiation fields encountered, a portable bandsaw was used to make the cuts in the sections with lower dose. A reciprocating saw that could be strapped to the pipe allowing personnel to step away during cutting was used for the pipe sections with higher dose. To mitigate any potential airborne release of contamination during the cutting operation, a negative pressure was maintained on the piping by pulling air through a high-efficiency particulate air (HEPA) filter unit attached to the radionuclide tank. This created an air flow that would pull any loose particulates into the pipe rather than being released to the surrounding area. Furthermore, a HEPA-filtered vacuum was positioned at the cut location to catch any particulate matter not captured by the filter hooked to the tank. The waste boxes selected were metal boxes approximately $0.60 \times 1.21 \times 1.8$ m ($2 \times 4 \times 6$ ft), with a rebar cage placed inside to keep the piping from touching the sides of the container. The box sides were lined with 1.27-cm (0.5-in.) cement board and a 7.62-cm (3-in.) layer of grout poured into the bottoms prior to placing the pipe.

Based on the radiation survey maps, the hotter sections of piping, such as that located inside the hot cell foundations, were isolated and placed in boxes with piping sections that had significantly lower (<1 mR/hr) radiation fields. To maintain worker exposures ALARA, an administrative limit/goal of 200 mR/hr at contact with all accessible surfaces of the boxes was established by the project team as a best management practice. Sections of piping with higher dose readings were placed in the centers of the boxes with piping having lower dose placed around them. The purpose behind this was to obtain the benefit of shielding with the lower dose pipe. Five boxes were filled with piping and surveyed for radiation levels on the exterior surfaces of the boxes. One box had a reading of 2 roentgen per hour (R/hr) at one end that was attributed to a piping section from the first hot cell. It was determined through calculations and verified in the field that in addition to the low-density grout that would be added to each box, 5.08 cm (2 in.) of steel would reduce the radiation field to a level near the project administrative limit of 200 mR/hr. Steel endcaps were manufactured and placed on the two ends of the hot pipe. Low-density grout was added to the waste boxes, thereby completely encapsulating the piping. The five boxes were then shipped to the Staging and Storage Annex (SSA) located at INTEC for eventual disposal in the ICDF.

After excavation, the ARA-16 piping and underlying soils were visually inspected for evidence of leaks. Additionally, after the piping was removed, the bottoms and sides of the trenches and the stockpiled soil from the trenches were surveyed with an in situ germanium spectrometer to verify that there were no residual gamma-emitting contaminants in the soils. All of the excavated soils, with the exception of one location approximately 15 ft in diameter, were below the 23-pCi/g remedial action goal for Cs-137 in soils. The soils in the hot spot were excavated and segregated from the rest of the soils and screened for the presence of organic contamination. The organic field screening results did not indicate the presence of any organic contamination; therefore, the identified Cs-137 was assumed to be from the SL-1 reactor accident. The segregated soil was sampled to verify that no hazardous contamination was present. Analytical results demonstrated that Cs-137 was the only contaminant present at levels of concern; therefore, this soil was placed in a soft-sided sack with the concrete rubble and gravels from the ARA-16 tank vault for disposal at the RWMC.



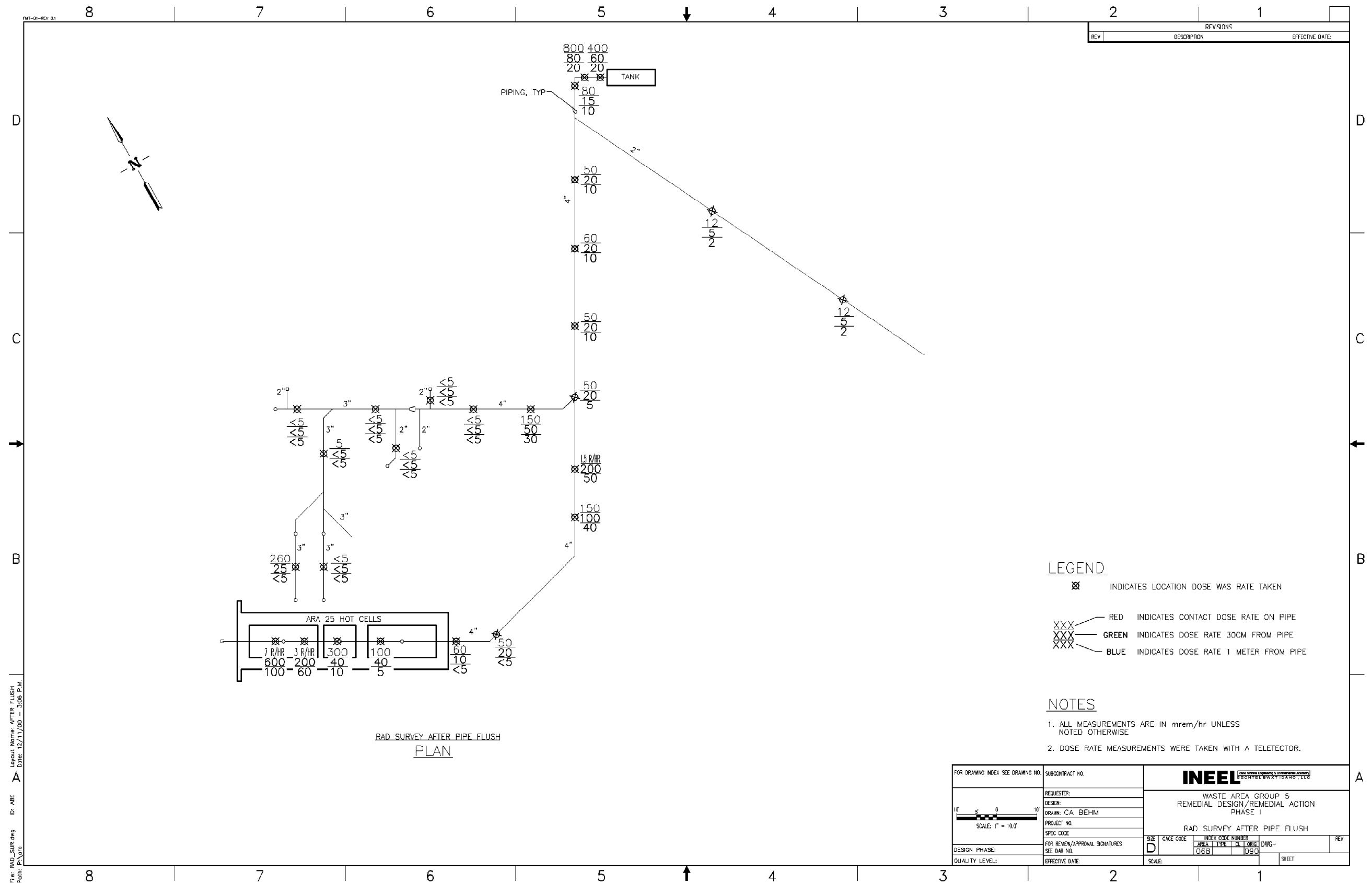


Figure 2-4. Radiation survey map following decontamination.

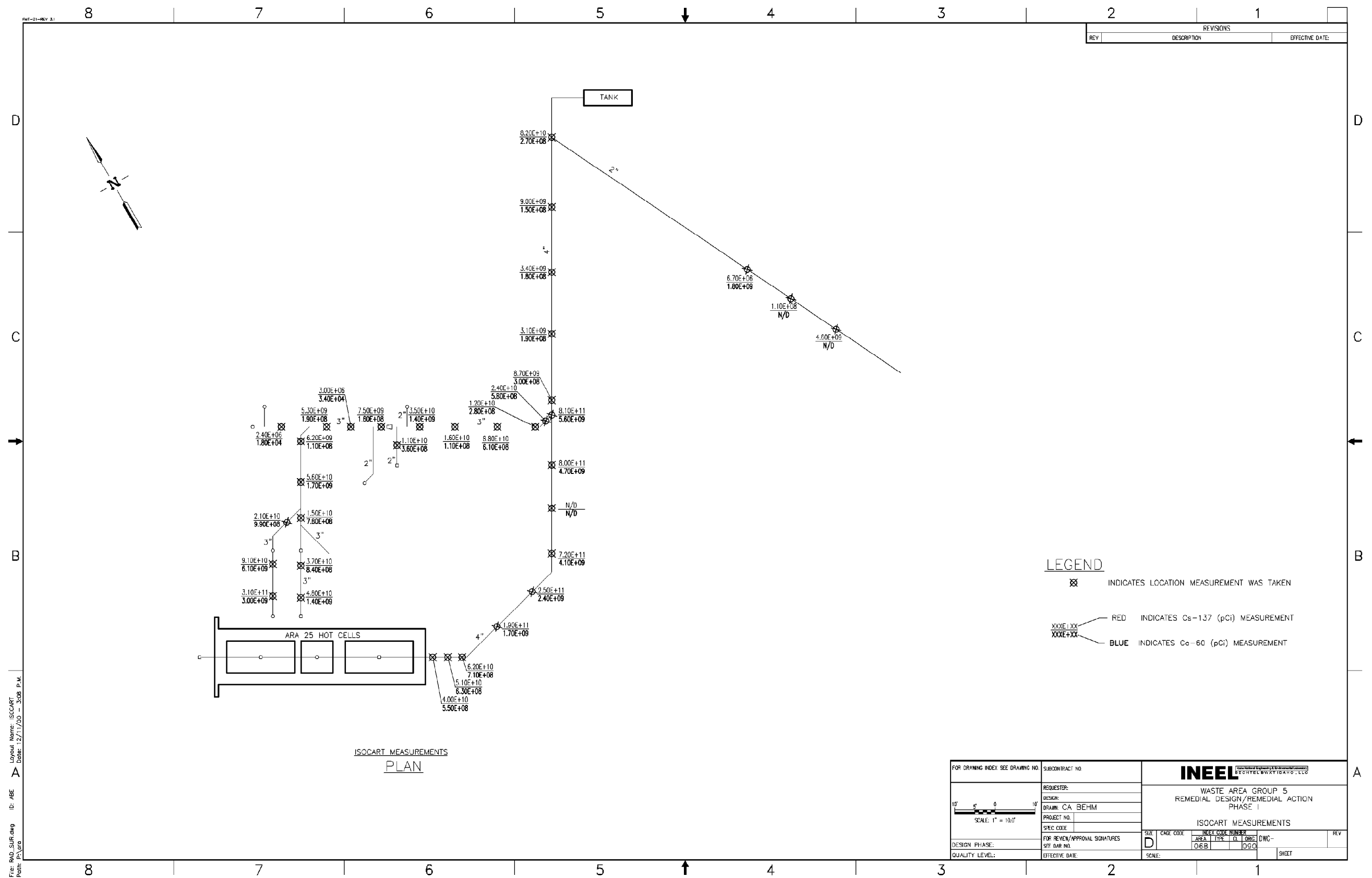


Figure 2-5. ISO-CART survey results.

The waste in the ARA-16 tank contained high concentrations of radionuclides, toxic metals, and organics, including PCBs. Based on sampling results and process knowledge, the waste was considered low-level radioactive mixed waste and was identified as RCRA-listed waste code F001 for trichloroethylene, methylene chloride, and 1,1,1-trichloroethane, and waste code F005 for toluene. Additionally, the waste was classified as RCRA-characteristic for trichloroethylene. The PCB Aroclor-1260 was detected at a maximum concentration of 98 ppm in the sludge; therefore, the sludge was also regulated under TSCA.

The liquid and sludge were removed from the tank using a peristaltic pump into a high-integrity container (HIC) equipped with dewatering internals. The liquid and sludge mixture was removed from the tank in two lifts to ensure that the HIC was not overfilled. The tank was rinsed using a high-pressure washer to remove as much sludge as possible from the tank. The rinse water was in turn pumped into the HIC. Following each transfer of waste from the tank, the water was separated from the sludge using the dewatering internals in the HIC. The water was pumped from the HIC using a second peristaltic pump, passed through a carbon filter to reduce volatile organic compound (VOC) concentrations in the water to meet the ICDF's waste acceptance criteria for land disposal restrictions, and pumped into 208-L (55-gal) drums with liners. A sodium polyacrylate monopolymer was added to each drum (20 lb prior to filling with 10 lb added after) to stabilize the water. The polymer and water readily intermix allowing the polymer to come in contact with all water in the drum. This was visually apparent as the polymer stabilized the water from the bottom of the drum up. Prior to closing the drum, additional polymer was added to the already stabilized water to ensure an excess of polymer was present. The first and last drum filled during each dewatering run was sampled for VOC analysis to demonstrate the efficacy of the carbon filter.

The HIC containing sludge and the carbon filter were placed in the PBF-ARA-I-CARGO-A CWSA that is an approved, compliant storage unit for TSCA- and RCRA-regulated wastes. Temporary lead shielding was placed around the HIC to reduce the exposure rate inside and outside the CWSA. To facilitate weekly and monthly inspections, mirrors were installed in the storage unit in an effort to reduce worker exposure. The sludge will be stored at this location until an approved TSDF is available to accept the waste. The Allied Technology Group, Inc. (ATG) located in Richland, Washington, is a mixed waste treatment facility under consideration for treatment of the ARA-16 tank waste sludge. The ATG facility was in the process of obtaining EPA approvals to begin commercial processing of TSCA-regulated wastes. The viability of ATG as a disposal facility for the ARA-16 sludge is questionable due to financial difficulties. Alternative disposal options are being investigated. The requirement to monitor the CERCLA Waste Storage Unit on a regular basis will be added to the WAG 5 Operations and Maintenance Plan.

To verify that the waste had been removed to the extent practicable, the interior of the tank was visually inspected using a remote video camera. The tank vault was partially excavated, and the vault walls were partially removed using a hydraulic hammer. Gravel was removed to allow access to the tank. The tank was collapsed to approximately 50% of its original volume and removed from the vault. The tank was partially filled with grout, placed into a pre-built form, and grouted full to encapsulate the entire tank meeting the RCRA and TSCA land disposal requirements. Debris generated during the ARA-16 remediation activities was grouted in waste boxes in a similar manner. The form containing the encapsulated tank and the grouted waste debris boxes were shipped to the SSA for eventual disposal in the ICDF. The concrete rubble, gravel contained in the vault, and contaminated soils were removed; packaged in soft-sided containers; and dispositioned as low-level radioactive waste at the RWMC.

2.3.2.6 ARA-21 ARA-IV Test Area Septic Tank and Leach Pit No. 2. Based upon review of existing analytical data and anecdotal information, it was determined that the matrix of the tank contents needed to be determined, and additional analytical data were required on the contents. Prior to any remedial activities, access ports to the septic tank and chlorine contact tank were opened and it was

determined that both tanks contained liquids. Samples were collected and analyzed for a specified list of radiological and nonradiological analytes in accordance with the Phase I Field Sampling Plan (DOE-ID 2000b). Results from the sampling, as provided in Section 2.4 and Appendix C, indicated that the liquids in both tanks contained no detectable man-made radionuclides nor did they need to be characterized as being hazardous or classified as TSCA-regulated. Based on the analytical results, contents (estimated between 1,893 and 3,785 liters [500 and 1,000 gallons]) were pumped from the tanks and transferred to the CFA sanitary sewage system for disposal. The metal manholes, piping, and lids from the tanks were excavated, removed, and dispositioned in the CFA landfill. Holes were placed in the bottoms of the tanks, and the tanks were filled with clean earthen material and abandoned in place in accordance with IDAPA standards, as outlined in IDAPA 58.01.03.007, “Septic Tanks Design and Construction Standards.”

2.3.2.7 ARA-25 Soils beneath the ARA-626 Hot Cells. The overlap of the ARA-25 and ARA-16 areas necessitated the removal of the concrete and contaminated soils associated with the ARA-25 site. The temporary roof covering the ARA-25 area was removed, surveyed for radiological contamination, sized, and disposed at the CFA landfill. The soils and concrete foundation were removed in two stages. Initially, the soils covering the ARA-16 piping inside the hot cell foundations were removed and placed in soft-sided containers. After the ARA-16 piping had been removed and packaged, the remainder of the ARA-25 soils was removed. The ARA-626 hot cell foundation was sized and placed in soft-sided containers with the soils. Parsons Infrastructure and Technology Group, Inc. prepared a hazardous waste determination documenting that the soils were nonhazardous waste (Parsons 1999). The soils and concrete from the foundations were disposed on-Site at the RWMC as low-level waste.

2.4 Sampling and Analysis

Sampling and analysis were performed in support of the Phase I remedial activities to provide waste characterization data and to demonstrate the effectiveness of the remedial action. As detailed in the Phase I Field Sampling Plan (DOE-ID 2000b), sampling was required for all the remediated sites with the exception of the ARA-07 and ARA-08 sites. It was determined that sufficient analytical data existed to show that these sites did not contain any contamination presenting unacceptable risks to humans or the environment. A summary of the existing analytical data collected in support of the remediation of the ARA-02, ARA-16, and ARA-25 sites as well as the closure of the ARA-13 and ARA-21 septic systems is presented in Appendix C.

2.4.1 ARA-02 Sanitary Waste System

Sampling activities at ARA-02 included the sampling of three septic tank vessels, the seepage pit pumice blocks, manholes, and concrete piping. A summary of the sampling conducted is as follows:

- Septic tanks—a composite consisting of six subsamples from each of the three tanks. The subsamples were collected from the sides, top, and bottom of the tanks.
- Seepage pit pumice blocks—a single composite consisting of six subsamples was collected from the pumice blocks.
- Manhole structures—a single composite consisting of four subsamples from each of the three manholes.
- Pipelines—a single composite of samples was collected from the two waste containers that held the sized concrete piping. Additionally, one VOC sample was collected from each of two piping containers.

- Rinsate—a single rinsate sample was collected from the decontaminated sampling equipment to satisfy the quality assurance requirements for the field operations.

Analyses for all samples listed above included gross alpha, gross beta, gamma spectroscopy, PCBs, semivolatile organic compounds (SVOCs), toxicity characteristic leaching procedure (TCLP) metals, and VOCs. Analyses for Septic Tank #1 and the seepage pit blocks excluded VOC analyses; however, dioxins and furan analyses were included in the analyses of the seepage pit block sample in accordance with the Field Sampling Plan for the WAG 5 Remedial Action, Phase I (DOE-ID 2000b). Low levels of man-made radionuclides were detected in the concrete samples from the septic tanks including Co-60 (0.214 ± 0.022 to 0.404 ± 0.035 pCi/g) and Cs-137 (0.766 ± 0.052 to 4.01 ± 0.28 pCi/g). Other radionuclides, detected at concentrations near background levels, included K-40 (11.6 ± 0.6 to 19.9 ± 1.1 pCi/g) and Ra-226 (0.568 ± 0.074 to 1.00 ± 0.10 pCi/g). Low levels of radioactivity were also detected in the sample from the seepage pit blocks including Co-60 (0.256 ± 0.027 pCi/g), Cs-137 (11.4 ± 0.6 pCi/g), Eu-152 (0.214 ± 0.058 pCi/g), K-40 (29.1 ± 1.5 pCi/g), Ra-226 (1.64 ± 0.16 pCi/g), and U-235 (0.497 ± 0.122 pCi/g).

The samples collected from the manholes also showed low levels of radioactivity, with the exception that man-made radionuclides were not detected in the sample from Manhole #1. The concentrations in the manhole structures were as follows: Co-60 (0.209 ± 0.020 to 0.217 ± 0.022 pCi/g), Cs-137 (2.14 ± 0.12 to 6.31 ± 0.34 pCi/g), K-40 (16.0 ± 0.9 to 19.1 ± 1.1 pCi/g), and Ra-226 (0.798 ± 0.086 to 1.02 ± 0.09 pCi/g); U-235 was detected in Manhole #2 at a concentration of 0.437 ± 0.090 pCi/g. The composite sample from the ARA-02 piping showed low levels of radionuclides including Cs-137 (0.320 ± 0.025 pCi/g), K-40 (18.2 ± 1.1 pCi/g), and Ra-226 (0.831 ± 0.088 pCi/g). Analyses for gross alpha and gross beta for all ARA-02 components were within the expected ranges, accounting for the quantities of Co-60, Cs-137, and K-40 present in each respective sample. Analytical results for VOCs, SVOCs, PCBs, dioxins and furans, and TCLP metals were either non-detects or under regulatory limits demonstrating that the waste met the RCRA land disposal restrictions. The analytical results for the ARA-02 remedial action are contained in Appendix C.

As mentioned previously, the excavations were visually inspected for evidence of contamination. In addition, the excavations were screened for the presence of VOCs and gamma emitters using a photoionization detector and radiological field instrumentation, respectively. As shown in Figure 2-2, the radiological survey results of the excavated area demonstrate that the Cs-137 contamination levels are below the soil cleanup goals as defined for surficial soils (i.e., 23 pCi/g for ARA-23), with the exception of a few isolated locations. The contamination is attributed to windblown spread associated with ARA-23 rather than leaks from the ARA-02 system. This is further supported by the fact that there was no visible contamination resulting from the septic system and the system was in good condition. These soils will be addressed during the remediation of the ARA-23 site.

2.4.2 ARA-13 ARA-III Sanitary Sewer Distribution Box and Septic Tank

Prior to any remedial action at the ARA-13 site, samples were collected to determine waste disposition paths for the septic system components (i.e., septic tanks [3], manhole, and distribution box) and the waste contained therein. Specifically, three sludge samples and one liquid sample were collected from the septic tank structure, two sludge samples and one liquid sample from the distribution box, and one sludge sample was collected from the manhole. Additional samples were planned for the structures themselves if the analytical data for the waste led to the determination that the waste was hazardous. However, based upon the analytical data, it was determined that the components would be abandoned in place in accordance with IDAPA standards, as outlined in IDAPA 58.01.03.007, “Septic Tanks Design and Construction Standards.” As a result, samples of the individual components were not required. Based

upon the analytical data contained in the closure plan for the site (INEL 1991), it was determined that the leach field associated with this site did not pose a problem and leaving it in place was the best practice.

The sludge samples were submitted for radionuclide, metals, VOC, SVOC, organo-chlorinated (OC) herbicide, OC pesticide, organo phosphorous (OP) pesticide, TCLP metal, TCLP VOC, TCLP SVOC, TCLP herbicide, TCLP pesticide, reactivity, and PCB analyses. Additionally, one sample of liquid waste was collected from the liquid present in the first septic tank. The analytical data for the prerediation sampling at ARA-13 are contained in Appendix C.

Radiological analyses showed that the liquid present in the septic tanks and in the distribution box did not contain any detectable quantities of man-made radionuclides. The gross alpha analytical results were within anticipated levels, ranging from 3.11 ± 0.86 pCi/g in the septic tank to 10.1 ± 2.6 pCi/g in the distribution box. Gross beta results ranged from 14.5 ± 1.6 pCi/g in the septic tank to 31.9 ± 2.6 pCi/g in the distribution box. The gross beta results were slightly elevated due primarily to the presence of elevated quantities of K-40 (6.65 ± 0.53 to 21.0 ± 1.2 pCi/g) and smaller quantities of Co-60 (0.219 ± 0.038 pCi/g in Septic Tank #2 only) and Cs-137 (0.032 ± 0.011 to 0.258 ± 0.022 pCi/g). Gamma-ray spectroscopy results were non-detects for gamma-ray-emitting radionuclides. To verify that there was no Sr-90 in the liquid, a sample was also collected for total strontium analysis. The results were non-detect for strontium with a minimum detectable activity of 4.17 pCi/L. Manganese-54 (Mn-54) was also detected in one sample from the distribution box at a concentration of 0.037 ± 0.011 pCi/g.

Analyses for metals, VOC, SVOC, OC herbicide, OC pesticide, OP pesticide, TCLP metal, TCLP VOC, TCLP SVOC, TCLP herbicide, TCLP pesticide, and reactivity were below RCRA regulatory limits in both the liquid and sludge components of the waste from the septic tanks and distribution box and the sludge in the manhole. PCB analyses for the sludge in the septic tanks and manhole showed that PCB concentrations were below the method detection limits with the exception of Aroclor-1254 at a concentration of 1.2 ppm in Septic Tank #3. PCB analyses of the distribution box sludge showed a maximum concentration of 60 ppm for Aroclor-1254, which exceeds the TSCA regulatory limit of 50 ppm. Therefore, the sludge from the distribution box was managed as TSCA-regulated, low-level waste. The sludges from the manhole and the septic tanks were managed as low-level radioactive waste.

2.4.3 ARA-16 Radionuclide Tank

Sampling activities during the ARA-16 remedial action included the following:

- Sampling of the tank liquid prior to remediation
- Radiological field screening of all external tank surfaces
- Radiological field screening of all piping
- Radiological and VOC field screening of all excavations and excavated and layback soils
- Samples of soils for laboratory analysis previously determined by field screening techniques to exceed remediation goals
- VOC samples of the ARA-16 liquid waste after filtering with activated carbon.

Prior to the removal of any of the ARA-16 piping or the liquid and sludge waste inside the tank, the liquid phase of the waste was sampled to verify that the pipe rinsing activities during FY 2000 did not appreciably increase the concentrations and types of contaminants in the liquid portion of the waste. The

liquid sampling results showed an increase in radionuclide concentrations over the previous analytical data—most notably Cs-137 from a maximum of 6.09×10^7 pCi/L to 1.58×10^8 pCi/L. The analytical results for VOCs and PCBs were consistent with the historical sample data and show that the ARA-16 liquid phase is RCRA listed, but not regulated under TSCA; therefore, the liquid phase was managed as low-level mixed waste.

The liquid and sludge wastes were removed from the tank onsite prior to removal of the tank. Sampling of the liquid and sludge was not required prior to shipping to an approved treatment and disposal facility since analytical data of sufficient quality and quantity already existed on that waste for the purposes of waste dispositioning. The ARA-16 liquid and sludge analytical data are contained in Appendix C. To determine compliance with the waste acceptance criteria for the final disposal locations, the 1997 sludge data will be used in combination with the liquid data from the 2001 sampling efforts. For disposal of the stabilized liquid, the 2001 liquid analytical data from the tank sampling will be used with the August 2001 VOC data being used to confirm compliance with the land disposal restriction requirements. The tank and piping were packaged and grouted in accordance with the Phase I RD/RA Work Plan (DOE-ID 2001), and the packages were screened for radiological contamination on the exterior surfaces to verify that exposure rates were <200 mR/hr and complied with applicable Department of Transportation standards. Additionally, the trenches and excavated soils were field screened for radiological and VOC contamination. The trenches were further characterized using the ORTEC ISO-CART gamma-ray spectrometer. The ISO-CART field measurement results are contained in Appendix E. Other than the one location discussed below, all other survey results demonstrated that no VOC contamination was present in the soils and Cs-137 concentrations were less than the remediation goal of 23 pCi/g.

One location (approximately 5 m [15 ft] in diameter) showed Cs-137 concentrations greater than the 23 pCi/g remedial action goal for soils. All other trenches met the specified limits and were backfilled. The soil in this one area was segregated and the trench resurveyed. The remaining soils were less than 23 pCi/g; therefore, the excavation was backfilled. The soil with the elevated readings was sampled for radionuclides, metals, VOC, SVOC, and PCB analyses. Other than the presence of Cs-137, no other contaminants known to be present in the tank waste were detected in the soil sample. Therefore, the source of the elevated Cs-137 contamination was attributed to surficial contamination resulting from the SL-1 accident rather than leakage from the piping.

2.4.4 ARA-21 ARA-IV Test Area Septic Tank and Leach Pit No. 2

Sampling activities at the ARA-21 site were performed prior to any remediation activities in order to determine waste disposition paths for the septic system components (i.e., septic tank and chlorine contact tank) and the liquid wastes contained therein. Specifically, one liquid sample was collected from each tank. Additional samples were planned for the structures themselves should the waste contained therein be determined to be hazardous. However, based upon the analytical data, it was determined that the components would be abandoned in place in accordance with IDAPA standards, as outlined in IDAPA 58.01.03.007, “Septic Tanks Design and Construction Standards.” As a result, samples of the individual components were not required.

The liquid samples were submitted for radionuclide, metals, VOC, SVOC, OC herbicide, OC pesticide, OP pesticide, TCLP metal, TCLP VOC, TCLP SVOC, TCLP herbicide, TCLP pesticide, reactivity, and PCB analyses. The analytical data for the prerediation sampling at ARA-21 are summarized in Appendix C. Radiological analyses showed that the K-40 was relatively high; however, this is to be expected in a septic system. Potassium-40 concentrations ranged from 85.8 ± 22.1 pCi/L in the septic tank to 97.0 ± 26.0 pCi/L in the chlorine contact tank. The elevated levels of K-40 are reflected in the gross beta results, which ranged from 42.4 ± 3.14 pCi/L in the septic tank to 62.8 ± 4.4 pCi/L in the

chlorine contact tank. Gross alpha concentrations were within normal levels. Analyses for metals, VOC, SVOC, OC herbicide, OC pesticide, TCLP metal, TCLP VOC, TCLP SVOC, TCLP herbicide, TCLP pesticide, and reactivity were below RCRA regulatory limits in the ARA-21 waste samples. The liquid waste was removed from the septic tanks and disposed of at the CFA sanitary sewer system.

2.4.5 ARA-25 Soils beneath the ARA-626 Hot Cells

The soils that were removed from within the hot cell foundations were previously characterized by D&D. These soils were field screened for radioactivity and VOC contamination during removal. There was no evidence of VOC contamination or spills; therefore, the soils were packaged in soft-sided containers and disposed at the RWMC as low-level waste. Appendix C contains the analytical data from the sampling of the soils contained in the hot cell performed during the D&D of the ARA-626 hot cells in 1998.

Following removal of the ARA-25 soils and the hot cell foundation to basalt, the basalt interface was surveyed using the ISO-CART gamma spectrometry system. Measurements were obtained at three locations within the excavation, each demonstrating that the Cs-137 concentrations exceeded the remediation goals. The results from the measurements performed at the north side of the excavation, middle of the excavation, and south side of the excavation were 58.9 pCi/g, 398.1 pCi/g, and 25.7 pCi/g, respectively.

2.5 Occupational Health and Safety

The following sections discuss the personnel radiological and industrial hygiene and environmental monitoring/sampling conducted on the OU 5-12 Phase I remedial action.

2.5.1 Radiological Control Monitoring

Radiological control monitoring was required at all task sites to mitigate the spread of radiological contamination, verify decontamination efforts, and maintain personnel exposures ALARA.

2.5.2 Industrial Hygiene Summary

2.5.2.1 Noise Surveillance. Personnel who operated heavy equipment and personnel working near the heavy equipment could have been exposed to average noise levels above 85 decibels for an 8-hour time-weighted average. Working in excess of the 85-dB time-weighted average noise level exceeds the Occupational Safety and Health Administration 29 CFR 1910.95 standard, requiring the project to implement the Company Hearing Conservation Program. The project industrial hygienist conducted routine noise assessments using the “A-scale” noise level measurements. The results of these noise assessments determined the need for hearing protection. Employees at the task site wore acceptable hearing protection (as required).

2.5.2.2 Heat and Cold Stress Surveillance.

The majority of the fieldwork took place in the hot summer months. The HASP (INEEL 2001) identified the need to ensure employees did not experience undue heat stress. This was accomplished by the industrial hygienist and the health and safety officer performing periodic surveillance of personnel and calculating stay times as the conditions dictated (i.e., personnel wearing PPE). Personnel were trained in identifying the symptoms of heat stress and how to handle a potential victim. Cool, potable drinking water was available at the task sites to help keep personnel hydrated.

2.6 Decontamination

Prior to removing materials and equipment from a radiological exclusion zone, the material and/or equipment was subject to decontamination. Contaminated objects were identified through the use of standard RadCon frisking methods and by analysis of smear (swipe) samples obtained from equipment. Any materials or equipment that were contaminated (100 cpm above background using a Ludlum 2A portable instrument) required decontamination prior to being removed from the controlled area.

Decontamination was performed per the requirements set forth in Section 10 of the project HASP (INEEL 2001). To limit the generation of any secondary wastes, dry decontamination methods using physical means were used to remove any contamination amenable to those methods. If the radiological control technician's survey of the material/equipment demonstrated that decontamination was successful, the object was released. If contamination was detected and could not be removed using dry methods, then wet methods were employed. Using a high-pressure, low-volume sprayer supplied by a water truck at the task site, equipment was decontaminated in the soil contamination area.

2.7 Site Restoration

Site restoration included contouring and reseeded those areas affected by the field activities. After preparation of a seed bed using a disc to till the top 7.6 cm (3 in.) of surface, fertilizer was applied at a rate of 50 pounds per acre. Seed was drilled to a maximum depth of 1.3 cm (0.5 in.) at a rate of 11 pounds per acre for the seed mixture. To maintain soil moisture levels, mulch was applied and placed in the soil at a depth of at least 5 cm (2 in.).

The reseeded was performed to stabilize the soils disturbed during the Phase I remedial activities. Several of the sites reseeded (i.e., ARA-02, ARA-07, ARA-08, ARA-16, and ARA-25) lie within the boundaries of the ARA-23 contaminated soil site. This contaminated soil site along with the ARA-01 and ARA-12 sites are tentatively scheduled for remediation to commence in June 2003 as part of the Phase II activities. As such, the reseeded areas will once again be disturbed during the Phase II remediation.

2.8 Demobilization

Final demobilization commenced at the end of September with the exception of activities involving final backfill and contouring of excavated areas at ARA-16 and ARA-25 and reseeded of affected areas. Final backfill and contouring of ARA-16/ARA-25 were completed in October 2001 with reseeded completed in November 2001. Demobilization from some sites (i.e., ARA-07, ARA-08, and ARA-02) actually consisted of leaving the equipment onsite since field activities at subsequent WAG 5 sites immediately start following completion of activities at those sites.